Modification of GMP 116 on Non-Gravel Drainfields Used According to Manufacturer's Specifications

Carl W. Thompson, P.E.
Infiltrator Systems, Inc.

AGENDA

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- GMP 116 Background
- Proposed Changes
- Performance in Virginia
- Non-Gravel System Background
- Research Supporting Proposal
- Summary and Questions/Discussion

GMP 116 Background

- GMP 116 was issued on April 15, 2002.
- Manufacturers meeting requirements of the policy for Substituted Systems shall be deemed to have met the requirements for a provisionally approved system.
- “A Substituted System authorized pursuant to this policy shall be considered a system with general approval pursuant to 448 of the *Regulations*.”
- Allows for substitution of non-gravel **STE** drainfield systems at 50% trench bottom area (typically 40-46% trench length) reduction under specific **CONDITIONS**.

GMP 116 Background

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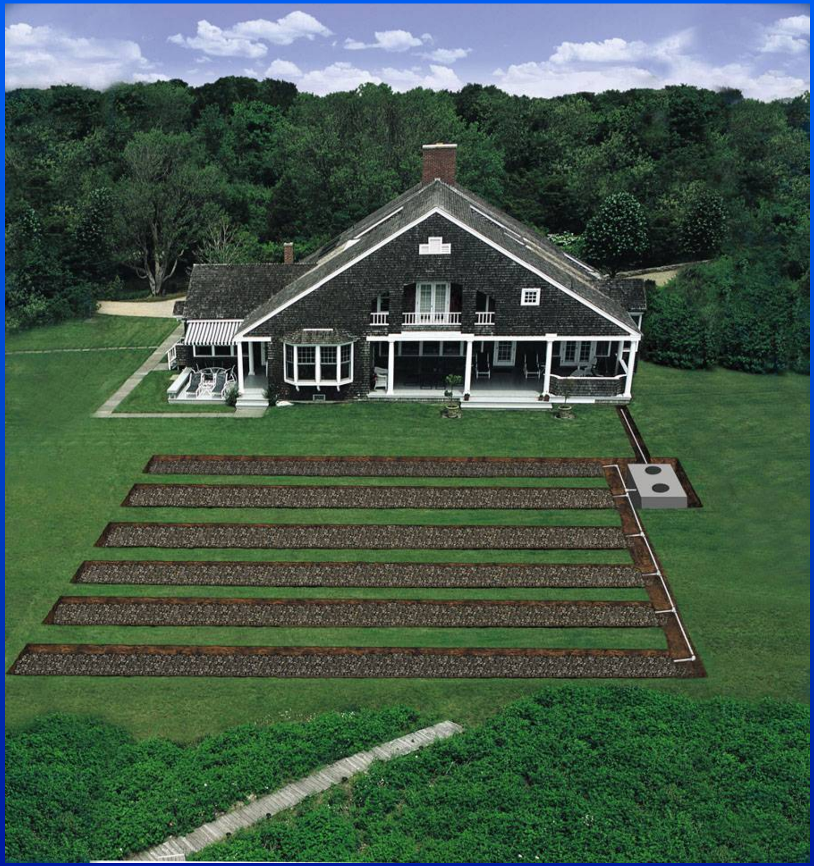
Manufacturers and Products Approved Under GMP #116

Revised: 11/17/05

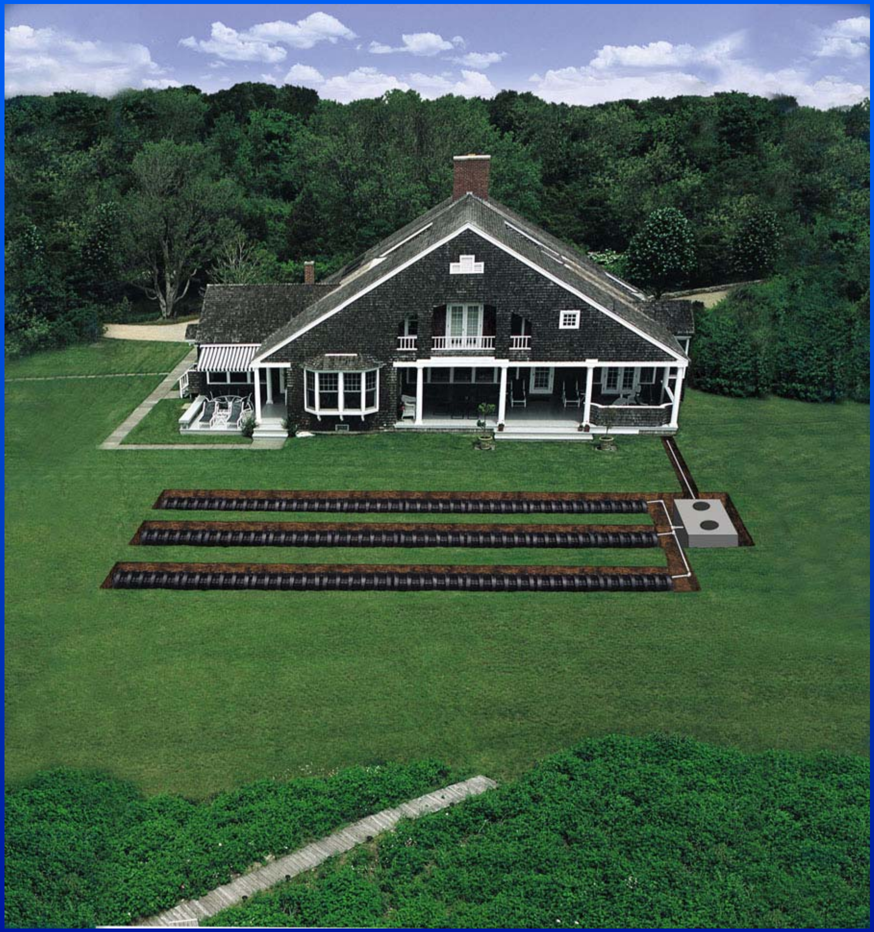
Manufacturer	Listed Products	Approval Granted	Latest Revisions	Approval Rescinded
Infiltrator Systems, Inc.	High Capacity SideWinder	5/20/02		
	Standard SideWinder	5/20/02	10/25/02	
	Standard	5/20/02	10/25/02	
	Equalizer 36	5/20/02		
	Equalizer 24	5/20/02	10/25/02	
	Quick 4	9/16/03		
Advanced Drainage Systems, Inc.	BioDiffuser - Standard	8/9/02	1/14/03	
	BioDiffuser - High Capacity	8/9/02		
	BioDiffuser - Bio 2	8/9/02	1/14/03	
	BioDiffuser - Bio 3	8/9/02		
	ARC 36	11/17/05		
	9-Pipe Multi Pipe System (includes LPD option)	12/01/03		
	11-Pipe Multi Pipe System	12/01/03		
	13-Pipe Multi Pipe System	12/01/03		
Ring Industrial Group, *EZflow*	EZ1203T	2/10/03		
	EZ1203H	2/10/03		
	EZ1402H	2/10/03		
	EZ1202H	3/14/06		
Hancor, INC.	EnviroChamber - Standard	7/20/04		
	EnviroChamber - Hi-Capacity	7/20/04		
	EnviroChamber - Narrow	7/20/04		

GMP 116 Background



Conventional Aggregate System

GMP 116 Background



Non-gravel System at Equivalent Sizing

GMP 116 Background

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The conditions….

1. Overall absorption area (the "footprint") shall be equivalent to a conventional gravel drainfield and maintained in reserve.
2. Limited to detached single-family dwellings with no more than 6 bedrooms.
3. Other than resizing the drainfield, the drainfield must be installed exactly as permitted.
4. "As-built" sketch of system must be submitted to local health department at time of inspection.
5. Manufacturer must provide a full written 5 year performance warranty.

GMP 116 Background

The conditions….

6. Manufacturer must provide annual verification of financial assurance and performance reporting.
7. Manufacturer must provide certification of system installers.
8. Manufacturer must provide a design and installation manual.
9. Individual trench laterals must be at least 90% of the length of permitted gravel trenches.
10. Signed owner’s consent for substitution must be provided to the district or health department.
11. If plans were drawn by AOSE or PE, the owner must obtain written approval from the designer prior to substitution.

GMP 116 Background

The challenges….

- Chasing owner and AOSE sign-off paperwork is difficult and often doesn’t meet it’s intent (owner is developer - not the family that moves into the home)
- Additional sign-off paperwork implies additional liability. In reality systems authorized for use under GMP 116 have general approval pursuant to the regulations
- Meeting the 90% trench length requirement doesn’t work well with manufactured products that come in specific lengths

GMP 116 Background

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GMP 116 – Proposed Changes

The proposal….

- If drainfield trench length reduction substitutions don’t exceed 15 - 25% depending on soil type (instead of 46% reductions authorized now), then
- Homeowner and AOSE sign-off conditions and 90% trench length condition are removed

GMP 116 – Proposed Changes

The likely outcome….

System substitutions will move from 46% reductions to 25% reductions (systems increase in size by 39%) because paperwork burdens are removed resulting in:

- Safer systems
- A cleaner, less cumbersome permitting process

Non-Gravel System Performance Record

Infiltrator Chamber Systems in Virginia

Year	Number of ISI GMP 116 Systems Installed	Number of Reported Malfunctions
2002	1,264	2
2003	3,247	3
2004	5,546	8
2005	6,459	11
2006 (thru August)	3,706	11
Total	20,222	35 (0.2%)

Non-Gravel System Background

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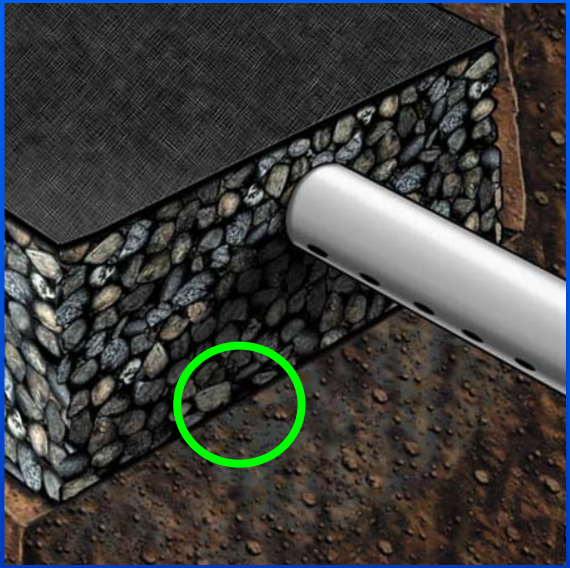
Aggregate-Free



Aggregate-Laden

Infiltrative Surface Architecture (ISA)

Non-Gravel System Background

- Approximately 2 million Infiltrator onsite systems installed over the last 20 years
- 48 out of 50 states allow for area reduction when chambers are used
- Chambers (certified per IAPMO PS 63) are included in the Unified Plumbing Code when sized at 70% of a gravel drainfield

Non-Gravel System Background

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United States Environmental Protection Agency | Office of Water Washington, D.C. | EPA 832-F-00-044 September 2000

EPA

Decentralized Systems Technology Fact Sheet

Septic Tank Leaching Chamber

DESCRIPTION

A leaching chamber is a wastewater treatment system consisting of trenches or beds, together with one or more distribution pipes or open-bottomed plastic chambers, installed in appropriate soils. These chambers receive wastewater flow from a septic tank or other treatment device and transmit it into soil for final treatment and disposal.

A typical septic tank system consists of a septic tank and a below-ground absorption field (also called a

Non-Gravel System Background

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To determine the total trench bottom area required, the design daily wastewater flow should be divided by the applicable LTAR. The minimum linear footage of the leaching chamber system should be determined by dividing the total trench bottom area by 1.2 meters (4 feet), when used in a conventional drainfield trench.

Excerpt from USEPA Fact Sheet:

Dividing trench area by 4 sf/ft allows for a 25% trench length reduction compared to 3’ wide gravel trench (identical to proposal)

Research Supporting Proposal

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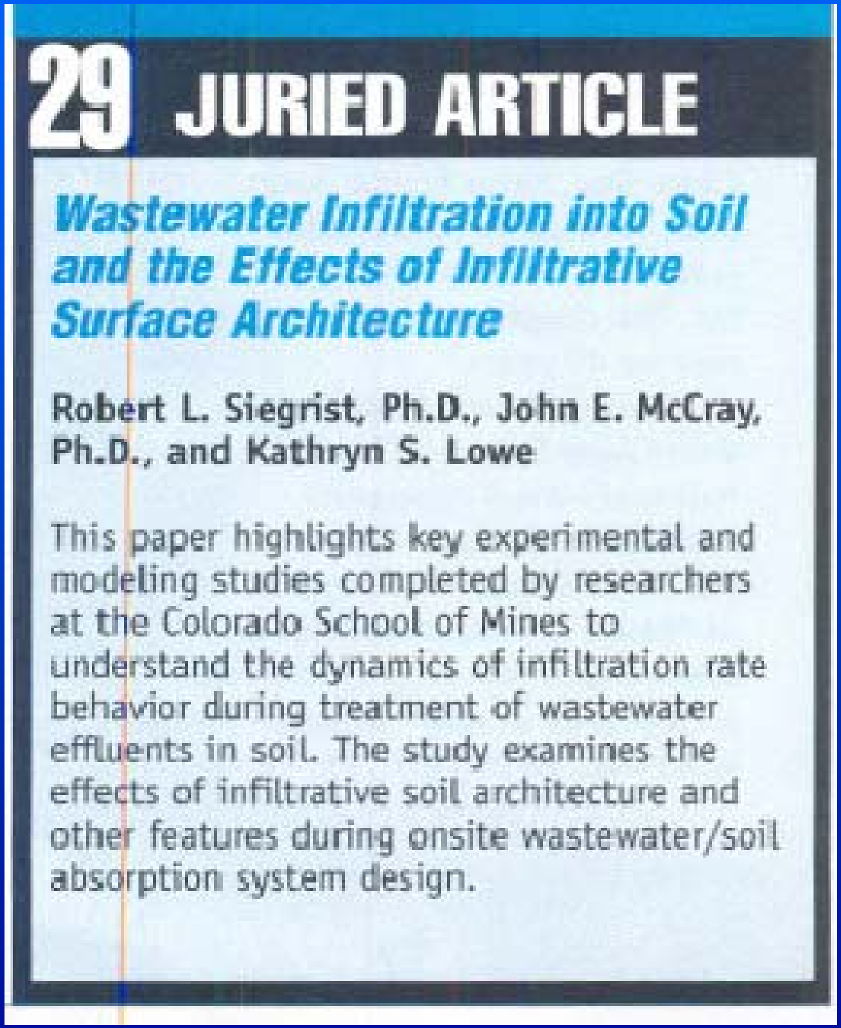
Small Flows Article



29 JURIED ARTICLE

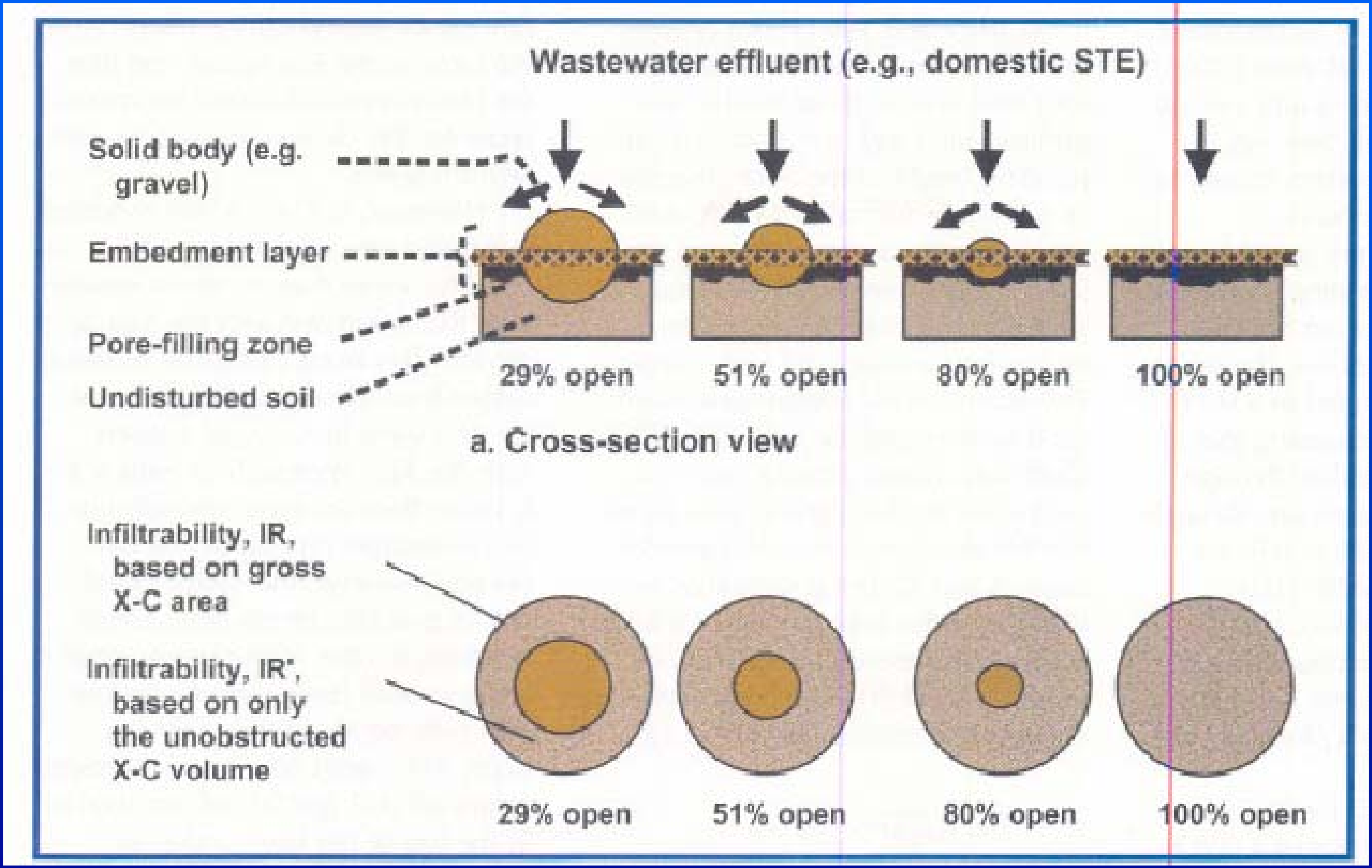
Wastewater Infiltration into Soil and the Effects of Infiltrative Surface Architecture

Robert L. Siegrist, Ph.D., John E. McCray, Ph.D., and Kathryn S. Lowe

This paper highlights key experimental and modeling studies completed by researchers at the Colorado School of Mines to understand the dynamics of infiltration rate behavior during treatment of wastewater effluents in soil. The study examines the effects of infiltrative soil architecture and other features during onsite wastewater/soil absorption system design.

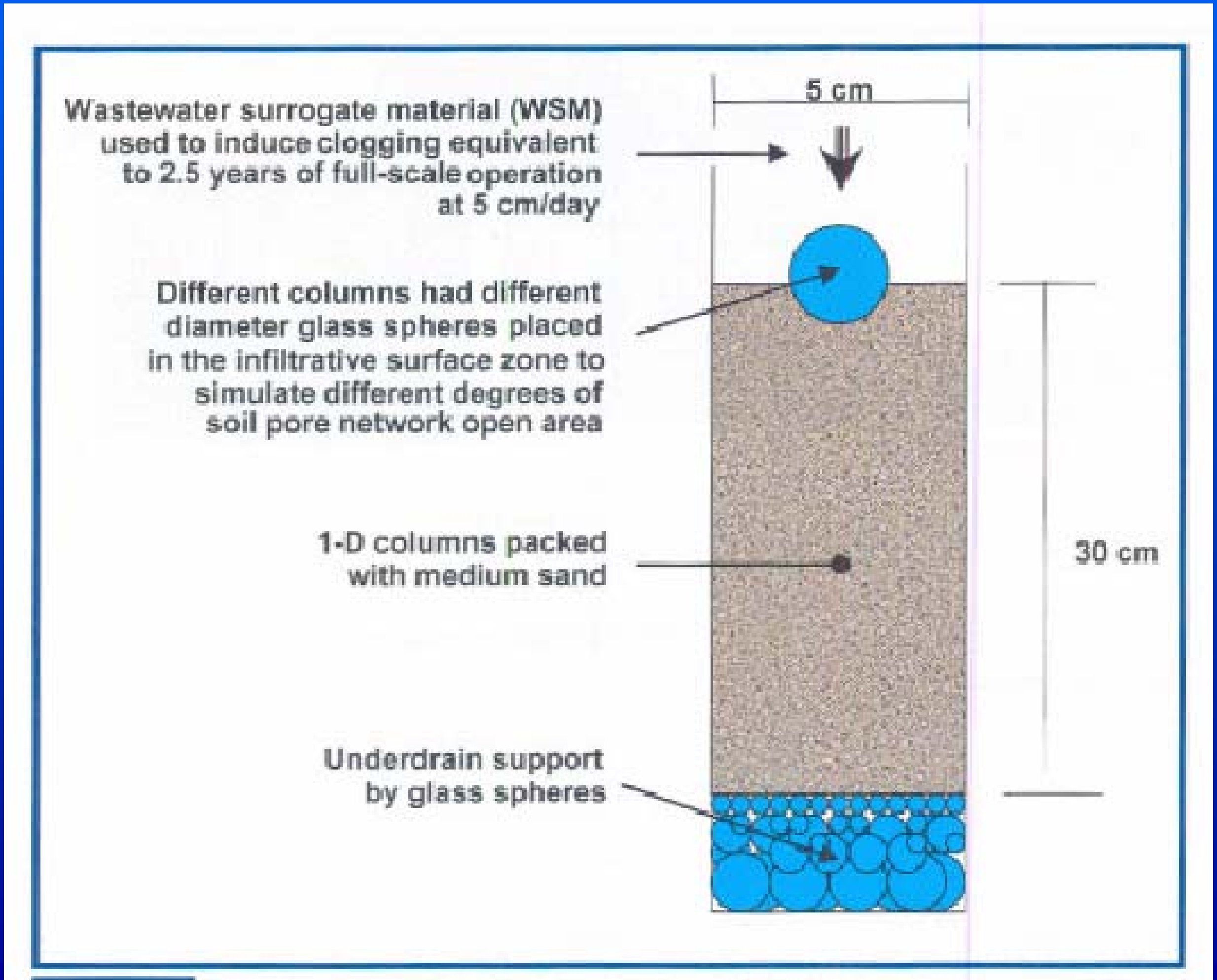
- A Juried (Peer-Reviewed Highest Quality) Summary of Research
- Provides Conceptual Basis for Performance Differences – Open/Stone Infiltrative Surface Architecture (ISA)
- Summarizes 3 New Research Studies

Small Flows Article
Conceptual Analysis



Small Flows Article

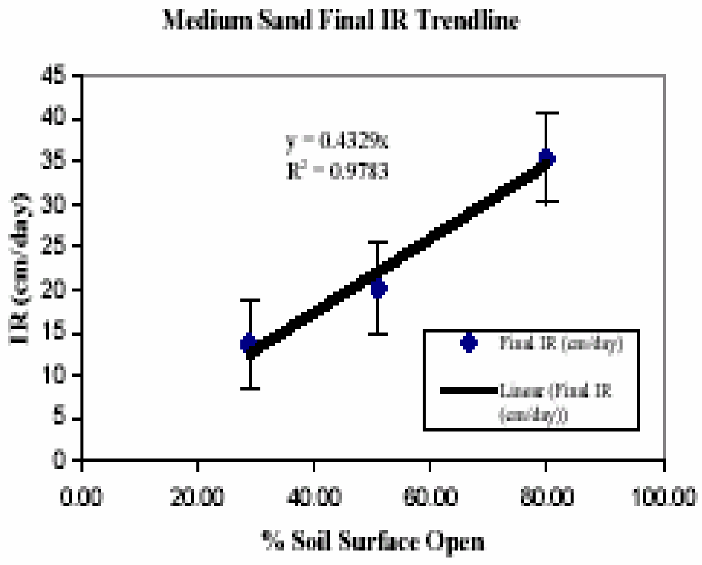
Effects of Solid Bodies on Infiltrative Surface (Diaz)



Small Flows Article

Effects of Solid Bodies on Infiltrative Surface (Diaz)

- Direct correlation between the open soil infiltrative surface in sandy soil and the infiltration rate after the addition of pore-filling materials equivalent to several years of effluent application



IR=0.43 x (% Open Area)

or

IR' = IR/((% Open Area)/100)

Field Research Experimental Approach

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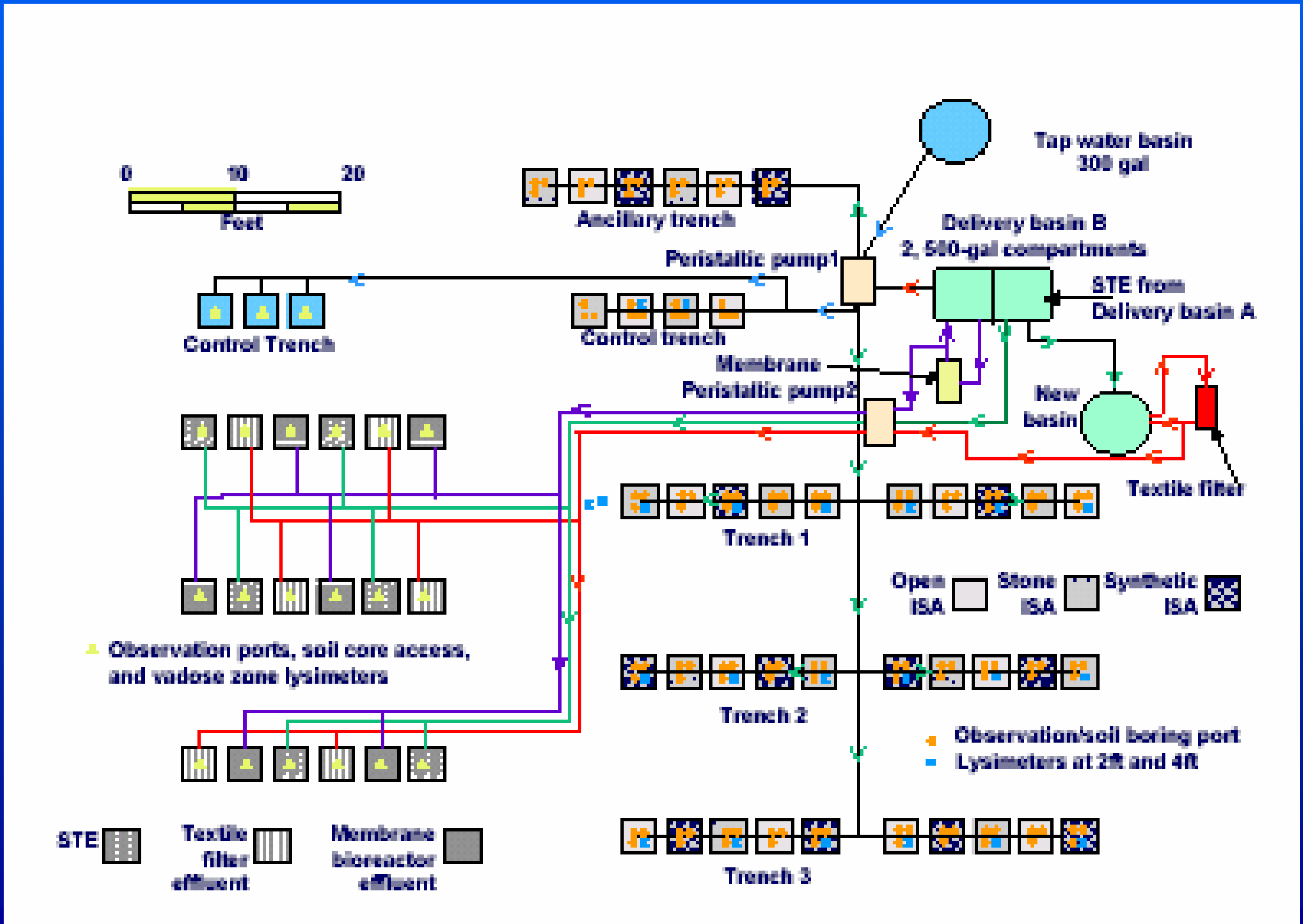
- Controlled field study with soil test cells
  - Factorial design (2 x 3)
    - 3 infiltrative surface architectures
      - Open, Gravel, Synthetic
    - 2 daily hydraulic loading rates
      - 4 and 8 cm/d (2x and 4x normal design rates)
      - Continuous loading for 16hr daily, 7 days a week,...
    - 5 replicates of each condition

Small Flows Article

Mines Park Field Study of ISA (Lowe & Tackett) .



Small Flows Article

Provides Conclusions and Implications

- (LTAR) for wastewater through an open infiltrative surface, such as a chamber, is 1.5 to 2.0 times higher than the LTAR for an infiltrative surface that is obstructed by rock in a trench.

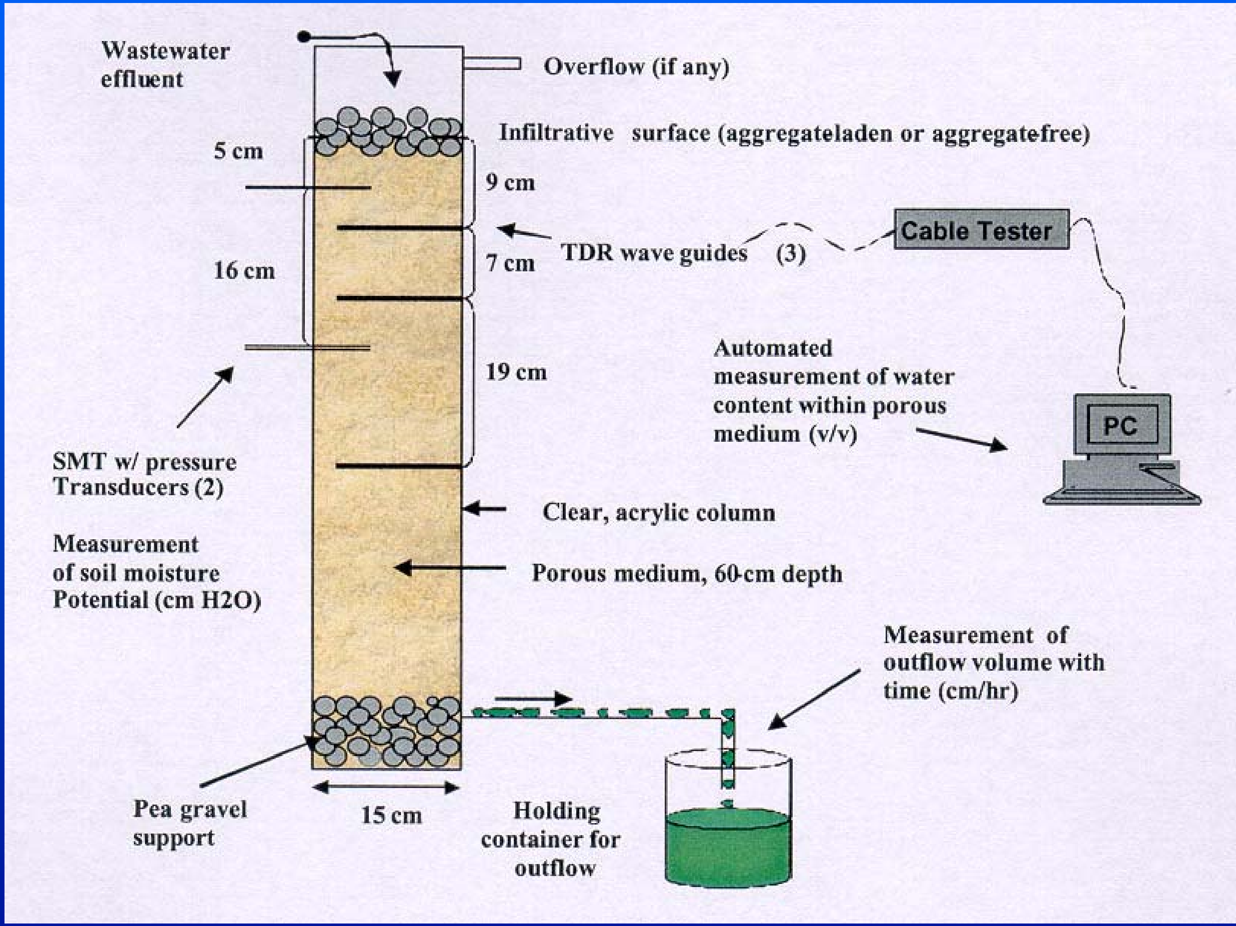
- In other words, a chamber system that is 50% to 67% of the length of a gravel system (as compared to the 75% - 85% sizing factor proposed) will provide the same infiltrative capacity as a full-length gravel system.

Small Flows Article

Provides Conclusions and Implications

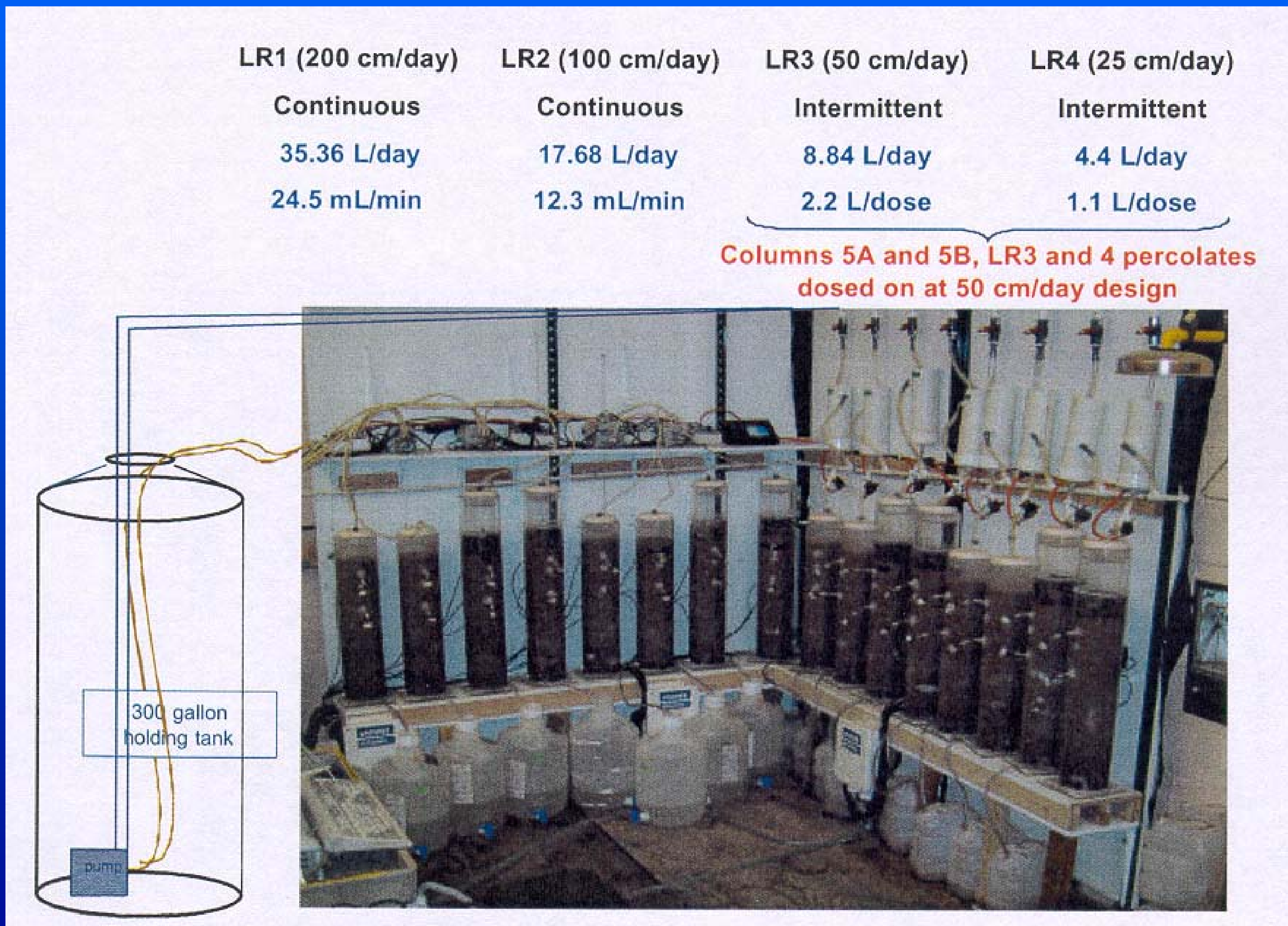
"The implications of these results are that a wastewater soil absorption system employing a chamber outfitted trench design can be sized with a smaller soil infiltration surface area compared to that required for a gravel-filled trench design"

Science Supporting Proposal



Walsh, 2006

Science Supporting Proposal



Science Supporting Proposal

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Walsh, 2006

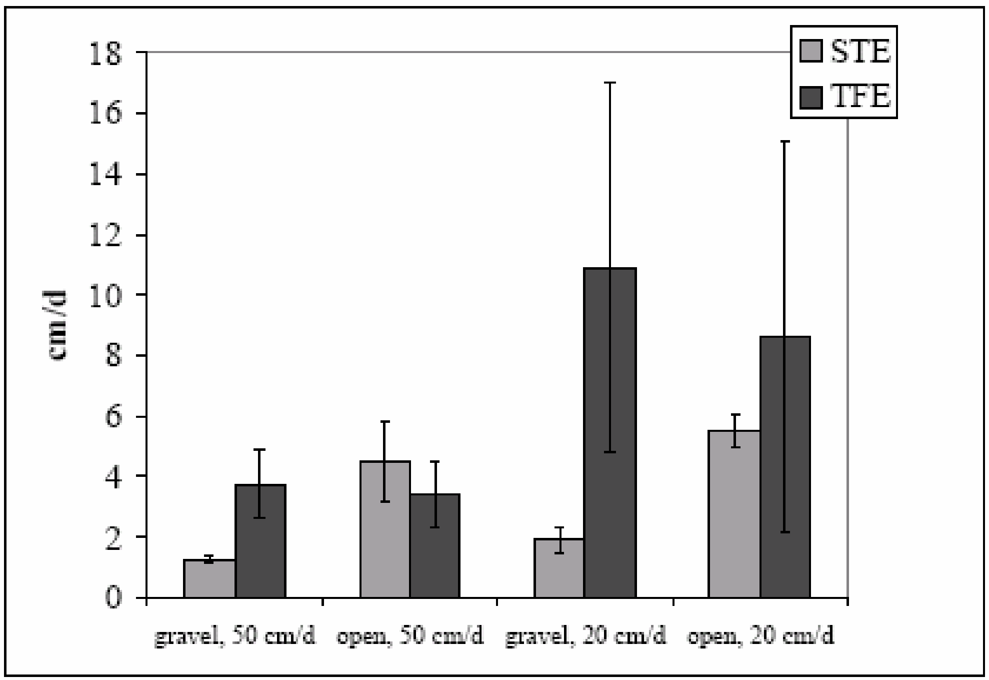

Figure 4-Average final acceptance rates for each condition
(error bars represent ± one standard deviation)
(n = 14 for both data sets)

Science Supporting Proposal

Walsh, 2006

The open [no gravel on soil interface] ISA had a higher infiltrative capacity than the gravel-laden ISA at the end of the project for columns receiving STE [septic tank effluent]. The ratio of open ISA to gravel-laden ISA mean final acceptance rates was 3.2. This has implications suggesting that open ISA would have more favorable long term hydraulic behavior when applying STE.

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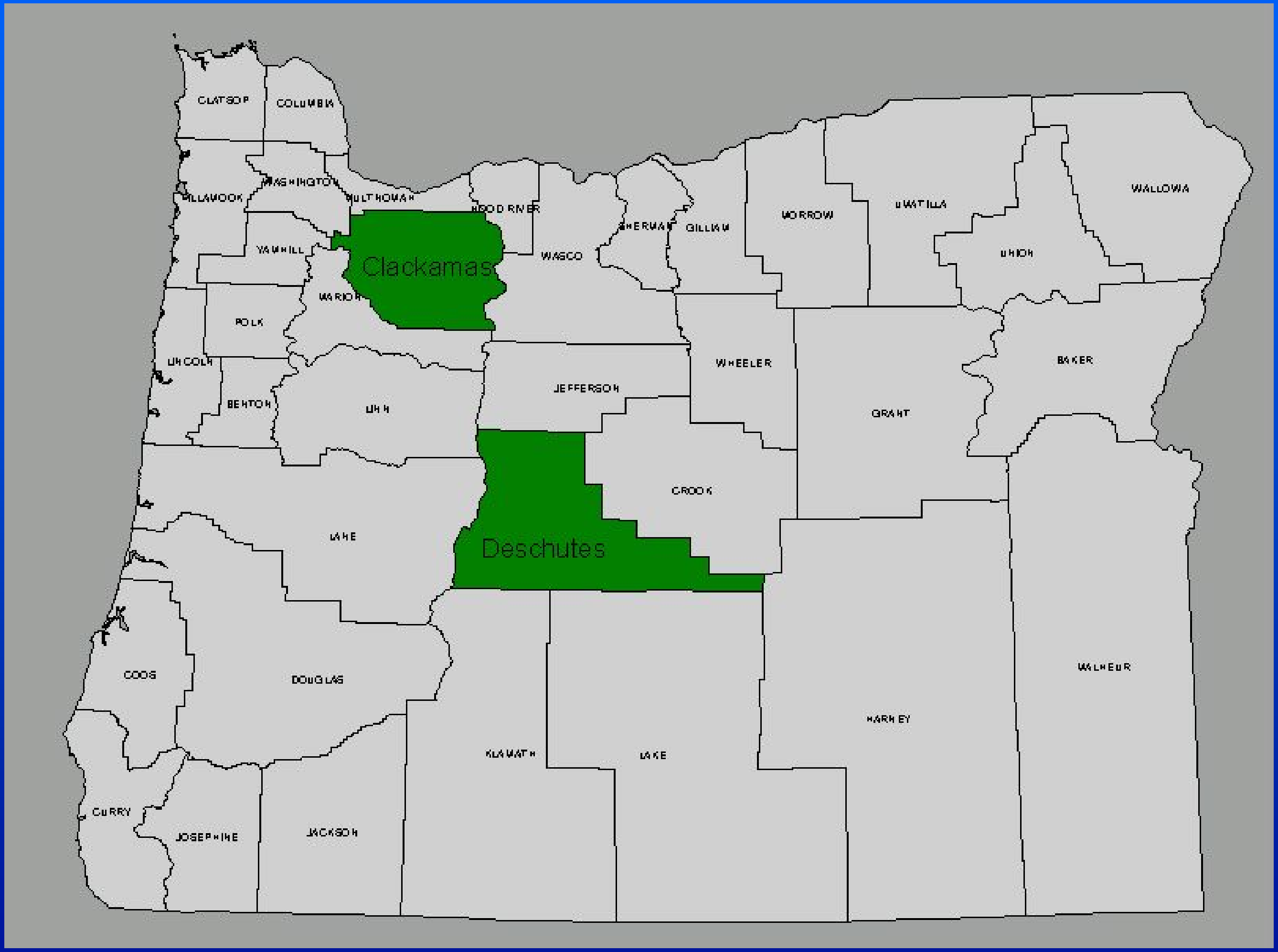
Independent, third-party research assessment of the hydraulic performance of Infiltrator EQ 24 chamber systems compared to 24” wide gravel and 4” pipe trenches (40% trench bottom area reduction).

Study Regions:
Cascade West and Cascade East



Statistical Analysis of Hydraulic Function

	Treatment (ISI Chambers)			Control (Aggregate)			Total Sample		
	H	$\hat{p}_1$	n	HF	$\hat{p}_2$	n	HF	Failure Rate	n
By soil grouping									
-high permeability	1	0.97a[3]	39	0	1.00a	44	1	1.2%	83
-moderate permeability	0	1.00a	71	2	0.97a	74	2	1.4%	145
-low permeability	1	0.99a	88	1	0.99a	73	2	1.2%	161
By climatic zone									
-humid temperate (CWR)	1	0.99a	99	2	0.98a	91	3	1.6%	190
-semi-arid (CER)	1	0.99a	99	1	0.99a	100	2	1.0%	199
All systems	2	0.99a	198	3	0.98a	191	5	1.3%	389

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Performance of Chamber and EZ1203H Systems Compared to Conventional Gravel Septic Tank Systems in North Carolina

R.L. Uebler, S. Berkowitz, P. Beusher, M. Avery, B. Ogle, K. Arrington and B. Grimes

Abstract

The North Carolina On-Site Wastewater Section conducted a statewide survey, which compared the performance of chamber and EZ1203H systems with 25% trench length reduction to conventional gravel systems. A total of 912 systems were randomly chosen in 6 counties across the state. To control evaluation bias, a group of students from Western Carolina University were hired to inspect each system. A system was considered to have failed if there was evidence of sewage at the ground surface or if an owner reported problems with the system. The statewide failure rate of both standard chamber and EZ1203H systems compared to conventional gravel systems was not statistically different at a 95% confidence level.

Uebler et al, 2006

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Soil Group	Texture Family (USDA)	Texture Class (USDA)	LTAR (gpd/ft^2)
I	Sands	Sand, Loamy Sand	1.2 to 0.8
II	Coarse Loams	Sandy Loam, Loam	0.8 to 0.6
III	Fine Loams	Sandy Clay Loam, Silt Loam, Clay Loam, Silty Clay Loam, Silt	0.6 to 0.3
IV	Clays	Sandy Clay, Silty Clay, Clay	0.4 to 0.1

The trench bottom area is then calculated by dividing the design flow, 120 gpd per bedroom, by the LTAR. Trench length is then determined by dividing the required trench bottom area by the trench width of 3 feet.

The chamber systems surveyed in this study were the standard design, which had an average open bottom width of about 29 inches and height of about 12 inches. The polystyrene aggregate systems surveyed were the EZ1203H, which is 12 inches high and 36 inches wide. The North Carolina approval for the both the standard chamber and the EZ1203H, allows for a 25% reduction in trench length compared to a conventional gravel trench system. Other trench requirements for chambers and EZ1203H systems are the same as for conventional systems. Trenches are dug with a 3-foot width, and placed on 9-foot centers, if multiple trenches are required.

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The following questions were answered with a yes or no by the survey team for each system inspected:

1.) Is sewage ponded on the surface?
2.) Does pressure to the soil surface with a shoe result in sewage coming to the surface?
3.) Is there a straight pipe?
4.) Is there evidence of past failure?
5.) Is there evidence of a repair?

In addition, an attempt was made to interview the occupants at each survey site in person or by phone. Answers to the following questions were obtained during the interview:

1.) Has your tank been pumped for other than routine maintenance?
2.) Are you having any of the following problems with your system today: surfacing on the ground; wet over system; odors; back up into the house; other?
3.) Have you had problems with the system in the past: surfacing on the ground; wet over system; odors; back up into the house; other?
4.) How was the problem solved?
5.) Has system been repaired or replaced?

A yes for one or more of the above questions answered by the survey team or the occupant was considered to be a system failure. More information was collected, but was not used to determine system failure.

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Table 1. System failure rate for conventional gravel, chamber, and EZ1203H systems.

System Type	Systems OK	Systems Failed	Total	Percent Failure
Gravel	281	22	303	7.3
Chamber	277	26	303	8.5
EZ1203H	277	29	306	9.5
Total	835	77	912	8.4

Table 2. System failure rate by physiographic region disregarding differences in system type.

Physiographic Region	Systems OK	Systems Failed	Total	Percent Failure
Coast	256	34	290	11.7
Piedmont	286	31	317	9.8
Mountain	293	12	305	3.9
All Regions	835	77	912	8.4

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Table 3. System failure rate by age group disregarding differences in system type.

System Age	Systems OK	Systems Failed	Total	Percent Failure
2 to 4 years	283	24	307	7.8
5 to 7 years	351	26	377	6.9
8 to 12 years	201	27	228	11.8
All Ages	835	77	912	8.4

Summary

The purpose of this survey was to determine if there was a difference in the failure rate of chamber and EZ1203H systems compared to gravel. Based on the data collected, the statewide failure rate of both standard chamber and EZ1203H systems compared to conventional gravel systems was not statistically different at a 95% confidence level. In laymen's terms, we would say that the chamber and EZ1203H systems performed the same as gravel systems.

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North Carolina Compared to Virginia

a. When a permit or authorization is issued for a conventional system, the permit or authorization shall contain a statement that indicates that an accepted system may also be used. These accepted systems may be installed without permit/authorization modification, prior approval of the health department, or separate owner sign-off, if the accepted system can be placed in the permitted/authorized trench footprint and the installation is in accordance with the accepted system approval, without unauthorized product alteration.

b. When substitution with one of these accepted systems for a conventional system or another accepted system is made, permit modification, prior approval of the heath department or separate owner sign-off is not required as long as no changes are necessary in the location of each nitrification line (except reduction in line length and/or number as allowed for in this approval), trench depth, or effluent distribution method.

North Carolina “Accepted System” Approval

North Carolina Compared to Virginia

How do system sizes compare in NC vs. VA?

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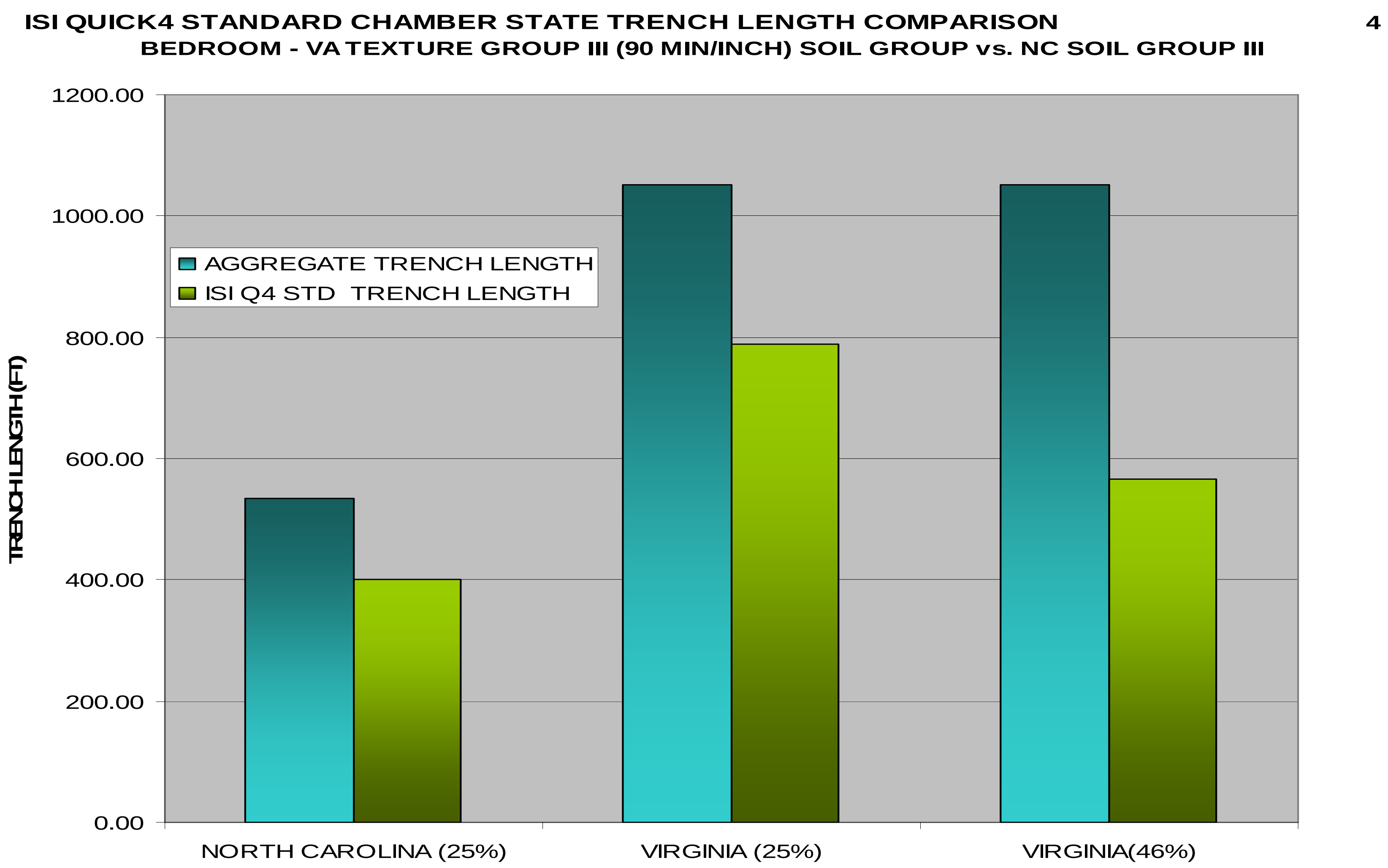

Science Supporting Proposal

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ISI QUICK4 STANDARD CHAMBER STATE TRENCH LENGTH COMPARISON

DESIGN CRITERIA = VA TEXTURE GROUP III (90 MIN/INCH) SOIL GROUP vs. NC SOIL GROUP III

STATE	GPD PER BR	NUMBER OF BRS	DESIGN FLOW (GPD)	LOADING RATE (GPD/SF)	ABSORPTION AREA REQUIRED (SF)	GRAVEL TRENCH CREDIT (SF/LF)	GRAVEL TRENCH LENGTH (FT)	CHAMBER TRENCH CREDIT (SF/LF)	CHAMBER TRENCH LENGTH (FT)
NC	120	4	480	0.30	1600	3.00	533	4.00	400
VA (25%)	150	4	600	0.19	3158	3.00	1053	4.00	789
VA (46%)	150	4	600	0.19	3158	3.00	1053	5.58	566

Summary

The proposal….

- If drainfield trench length reduction substitutions don’t exceed 15 - 25% depending on soil type (instead of 46% reductions authorized now), then
- Homeowner and AOSE sign-off conditions and 90% trench length condition are removed

(Note: All other parts of GMP 116 remain in tact – warranty, footprint, financial assurance, as-builts, certification, etc)

Summary

- Third-party lab, pilot-scale, and field research support use of non-gravel systems at gross sizes smaller than gravel systems.
- Performance records in VA and in North America (over the past 20 years) indicate that non-gravel systems with reductions in the 40 – 50% range perform equivalently to gravel systems.

Summary

The likely outcome….

System substitutions will move from 46% reductions to 25% reductions (systems increase in size by 39%) because paperwork burdens are removed resulting in:

- Safer systems
- A cleaner, less cumbersome permitting process

Questions?

Thank You
Carl W. Thompson, P.E.
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